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FOURTH ANNUAL MEETING OF THE MATHEMATICAL ASSOCIATION OF AMERICA.

The fourth annual meeting of the Association was held at Columbia University on Thursday and Friday, January 1 and 2, 1920, in conjunction with the annual meeting of the American Mathematical Society, which was held on Tuesday and Wednesday, December 30 and 31, 1919. There were 143 in attendance at the sessions, including the following 108 members of the Association:

C. R. Adams, Brown University.
Joseph Allen, College of the City of New York.
R. C. Archibald, Brown University.
C. S. Atchison, Washington and Jefferson College.

Clara L. Bacon, Goucher College.
Ralph Beatley, Horace Mann School for Boys.
A. A. Bennett, University of Texas.
E. G. Bill, Dartmouth College.
C. L. Bouton, Harvard University.
Joseph Bowden, Adelphi College.
H. S. Brown, Hamilton College.
Daniel Buchanan, Queen's University.
R. W. Burgess, Brown University.

W. D. Cairns, Oberlin College.
Mary E. Caster, Paterson, N. J.
J. A. Clarke, W. Philadelphia High School for Boys.
J. B. Coleman, University of South Carolina.
G. M. Conwell, N. Y. State College for Teachers.
J. L. Coolidge, Harvard University.
Elizabeth B. Cowley, Vassar College.
C. H. Currier, Brown University.

Eleanor C. Doak, Mount Holyoke College.
E. L. Dodd, University of Texas.
Fletcher Durell, Lawrenceville School.

H. S. Everett, Bucknell University.

T. S. Fiske, Columbia University.
W. B. Fite, Columbia University.
J. A. Foberg, Crane Junior College.
T. M. Focke, Case School of Applied Science.

A. S. Gale, University of Rochester.
W. V. N. Garretson, Rutgers College.
R. E. Gilman, Brown University.
O. E. Glenn, University of Pennsylvania.
W. C. Graustein, Harvard University.

W. M. Hamilton, U. S. Nautical Almanac Office.
H. E. Hawkes, Columbia University.
Olive C. Hazlett, Mount Holyoke College.
E. R. Hedrick, University of Missouri.
A. A. Himwich, Physician, New York City.
Anna M. Howe, Dana Hall, Wellesley, Mass.
L. S. Hulburt, Johns Hopkins University.
W. A. Hurwitz, Cornell University.

Dunham Jackson, University of Minnesota.
S. A. Joffe, Asst. Actuary, Mutual Life Ins. Co.

Edward Kasner, Columbia University.

W. D. Lambert, Coast and Geodetic Survey.
Marcia L. Latham, Hunter College.
D. D. Leib, Connecticut College for Women.
Florence P. Lewis, Goucher College.
H. M. Lufkin, Cornell University.

H. B. Mitchell, Columbia University.
C. N. Moore, University of Cincinnati.
Frank Morley, Johns Hopkins University.
H. M. Morse, Harvard University.
F. D. Murnaghan, Johns Hopkins University.

E. J. Oglesby, New York University.
F. W. Owens, Cornell University.
Helen B. Owens, Cornell University.

George Paaswell, Civil Engineer, New York City.
Alexander Pell, Bryn Mawr, Pa.
Anna J. Pell, Bryn Mawr College.
S. S. Penn, New York, N. Y.
L. R. Perkins, Middlebury College.

Patrick Rafferty, Holy Cross College.
W. W. Rankin, Jr., University of South Carolina.
W. R. Ransom, Tufts College.
H. W. Reddick, Cooper Union.
L. J. Reed, Johns Hopkins University.
C. N. Reynolds, Jr., Wesleyan University.
J. B. Reynolds, Lehigh University.
R. G. D. Richardson, Brown University.
L. H. Rice, Tufts College.

Paul Saurel, College of the City of New York.
Raleigh Schorling, Lincoln School.
W. H. Sherk, University of Buffalo.
L. P. Siceloff, Columbia University.
W. G. Simon, Western Reserve University.
Lao G. Simons, Hunter College.

C. G. Simpson, Pennsylvania State College.
Mary E. Sinclair, Oberlin College.
H. E. Slaught, University of Chicago.
Clara E. Smith, Wellesley College.
D. E. Smith, Columbia University.
J. P. Smith, Georgetown University.
P. F. Smith, Yale University.
Sarah E. Smith, Mount Holyoke College.
W. M. Smith, Lafayette College.
Marion E. Stark, Wellesley College.

J. S. Taylor, Mass. Institute of Technology.
H. D. Thompson, Princeton University.
J. I. Tracey, Yale University.
A. B. Turner, College of the City of New York.
Bird M. Turner, Phebe Anna Thorne Model School, Bryn Mawr College.

P. H. Underwood, Ball High School, Galveston, Tex.
C. B. Upton, Teachers College.

H. S. Vandiver, Cornell University.

C. A. Waldo, Washington University.
Evelyn Walker, Hunter College.
J. L. Walsh, Graduate School, Harvard University.
H. E. Webb, Central High School, Newark, N. J.
Eula A. Weeks, Cleveland High School, St. Louis, Mo.
Mary E. Wells, Vassar College.
E. E. Whitford, College of the City of New York.
F. B. Wiley, Denison University.
W. A. Wilson, Yale University.
F. S. Woods, Mass. Institute of Technology.

J. W. Young, Dartmouth College.

S. D. Zeldin, Mass. Institute of Technology.

The general topic for all the sessions of this meeting was "Mathematics in Relation to the Allied Sciences." Speakers were invited from five different scientific fields; namely, Physiology, Crystallography, Physical Chemistry, Biometry and Vital Statistics, and Physics. In each session the number of papers was limited to two in order that ample time might be given to general discussion. The wisdom of this arrangement was fully justified as shown by the marked and prolonged interest in the discussion after each paper. It is worthy of note that among these five branches of science the one which seemed to call for the widest range of mathematical applications, as set forth by the various speakers, was in connection with research in Physiology. By common consent it was acknowledged that the Association is deeply indebted to these speakers for the information and inspiration contributed by them on this occasion. Credit is due to Professor H. E. Hawkes, chairman of the program committee, for the arrangement and successful outcome of the program.

On Wednesday evening, between the sessions of the Society and the Association, a joint dinner and social gathering was held in the new Students Hall of Barnard College where about 115 members and their friends were present. Professor E. W. Brown presided and short addresses were given by Professor Frank Morley, president of the Society, Professor H. E. Slaught, president of the Association, Professor Dunham Jackson, Professor T. S. Fiske, Professor R. G. D. Richardson, Professor H. E. Hawkes, and Professor J. L. Coolidge. The arrangements for the dinner and for all matters of comfort and convenience connected with the meetings were made by Professor T. S. Fiske, chairman of the committee on arrangements.

As usual at the annual meetings, interest in the election of officers of the Association grew in intensity and the balloting continued up to the hour of the business meeting on Friday morning. The total number of ballots cast was considerably larger than last year. It is hoped that the number taking advantage of this franchise privilege may steadily increase until a large percentage of the members shall become thus active.

At the close of the final session a formal and unanimous resolution was passed expressing appreciation of the hospitality of Columbia University, of the services of Professor Fiske as chairman of the committee on arrangements, and of Professor Hawkes as chairman of the program committee.

President Slaught presided at each of the three sessions. The following seven papers were read:

(1) "Mathematics for the physiologist and physician" by Dr. H. B. WILLIAMS, Assistant Professor of Physiology, College of Physicians and Surgeons.

(2) "The regular solids and the types of crystal symmetry" by Dr. P. L. SAUREL, Professor of Mathematics, College of the City of New York.

(3) "The mathematics of physical chemistry" by Professor G. B. PEGRAM, Dean of the School of Mines, Engineering, and Chemistry, Columbia University.

(4) "The mathematics of biometry" by Dr. L. J. REED, Associate Professor of Biometry and Vital Statistics, Johns Hopkins University.

(5) "An experiment in conducting freshman mathematics courses" by Dr. F. B. WILEY, Professor of Mathematics, Denison University

(6) Preliminary report of the National Committee on Mathematical Requirements by Dr. J. W. YOUNG, Professor of Mathematics, Dartmouth College.

(7) "Mathematics for students of physics" by Dr. LEIGH PAGE, Assistant Professor of Physics, Yale University.

Abstracts of the papers and discussions follow below, the numbers corresponding to the numbers in the list of titles:

(1) It seems to have been generally assumed that students intending to enter upon the study of medicine or the biological sciences need only the most elementary training in mathematics. The biological sciences in the main, however, rest entirely upon the fundamental sciences of physics and chemistry. Without adequate preparation in these sciences the biological student will be greatly handicapped in his studies and if he attempts in later life to enter upon serious original research in his chosen field he will meet almost insurmountable obstacles and be apt to commit most absurd mistakes.

The ideal preparation would be a very thorough training in physics, chemistry, and physical chemistry, with all the mathematical preparation which such training presupposes. Since this would be in itself the work of a life-time, some sort of compromise must be effected. A fairly definite list of the desirable courses in mathematics was given by Dr. Williams.

It was suggested that for students of medicine especially the usual courses in general biology, zoölogy, histology, comparative anatomy and the like be omitted from the preparatory course and mathematics, chemistry and physics be substituted. Given a good ground work in these fundamental sciences, the student will be able at any later time to extend his field of knowledge by independent reading without the help of instructors. Much of the work ordinarily taken in the academic courses by these students is duplicated in the medical school.

Medicine is both science and art. For those who aspire to know anything of the science, training in fundamentals is essential, and if one intends to participate in the advance of the medical sciences a very thorough training should be secured. The best work in physiology has always been done by men whose preliminary training was exceptionally good.

In the discussion of this paper, Professor Slaught told of a student holding the doctor's degree in zoölogy who is now taking a year's course in calculus because it was found necessary for later biological research.

Professor D. E. Smith gave voice to the general feeling of surprise on the part of the hearers that so extensive a training in mathematics was called for. In answer to his questions Dr. Williams stated (1) that students can ordinarily assimilate the material in plane and solid geometry most readily in their high-school years, can then best spare the time for that work and can at that period most easily get into their memory the facts of elementary mathematics; (2) that analytic trigonometry is a useful possession if a student has the time for its study, the speaker himself having used it in science related to medicine; and (3) that the hyperbolic functions are useful for the physiologist in alternating current theory, which is needful in certain researches in physiology.

In answer to inquiries made by Professor Hawkes, Dr. Williams gave further detailed suggestions. The theory of probability and of the errors of observation are important in their physiological bearings. Again, in the study of the nature of nerve impulse the simple physical theory proved inadequate to cover the facts and it was necessary to attack the investigation as a problem in electrical conduction on the theory that the nerve behaves like a submarine cable; measurements were made sufficient to compute the characteristics of the nerve and an artificial cable was constructed such that the curve of electrical response of the artificial cable could hardly be distinguished from that of the nerve studied. It was further found that the variations due to temperature changes agreed with the electrical theory. The studies on the heart by electrical means made by Eintoven of Leyden were possible because of his being well trained in mathematical investigation; his invention of an electrometer which is a well-known modification of the D'Arsonval galvanometer was directed by his study of mathetheory. Many times the physiologist meets with formidable mathematical notation in his reading of physics papers, and he should be able to command this as well as the purely physical material.

Professor Archibald drew attention to O. Fischer's article "Physiologische Mechanik (Bewegungsphysiologie)," 1904, with its bibliography of over four hundred titles, in *Encyclopädie der mathematischen Wissenschaften.*

Professor Jackson reported that Dr. Dryer of Minnesota in a recent address on the use of mathematics in medicine instanced the application of statistics to the study of blood pressure; when the blood volume in animals was compared with bodily weight, it was found that the former was proportional, not to the latter as formerly supposed, but more nearly to the bodily surface, this surface having been found experimentally to be approximately proportional to the twothirds power of the weight. There was no suggestion of any a priori reason for the relation between surface and weight such as would have been familiar to one trained in mathematics.

Professor C. N. Moore spoke of the curve representing the time-rate of healing of wounds, which follows an exponential law. Two observations made only a short time apart determine the curve and any important deviations from this curve occurring within the next few days indicate a pathological condition which calls for investigation.

Professor Hurwitz remarked that if the value of mathematics for the various sciences is to be emphasized, college teachers must be able to show such advantages not merely for the exceptional investigator, but as well for a considerable proportion of the students of science.

Professor Bennett related a case where the author of a paper at an educational gathering spoke of the area under a curve as representing the number of observations, and the chairman of the meeting remarked that the paper was very interesting but of course one could not expect to understand the mathematical portion! Professor Bennett also mentioned a limited study of periodic functions as desirable early in the course in algebra.

Professor Fiske closed the discussion by stressing the need of teaching more than the bare matter which the majority will probably use; rather is it our duty to continue as much as ever to give all the mathematical instruction which we find possible.

(2) The object of Professor Saurel's paper was threefold. In the first place, it was pointed out that, as the result of the work of Hessel, Bravais, Gadolin, Curie, and Lorentz, it was now possible to present in very simple form the solution of the problem of finding all the finite groups of operations that can be formed by means of rotations about axes passing through a given point and inversions with respect to that point. In the second place, it was shown that the solution of this problem leads directly to the enumeration of the types of crystal symmetry. Finally, a set of symbols and of names for the thirty-two different types of crystal symmetry was suggested which is believed to be simpler than any set in use at present.

Mr. Wintringham told of Jäger's work on crystal symmetry, the symmetry of animal and vegetable forms, including such studies as that of the pineapple.

Professor Archibald brought out the statement from Professor Saurel that Gadolin's contributions in respect of the thirty-two types of crystal symmetry were not essentially new, his axes of inverse symmetry being equivalent to Hessel's earlier treatment, viz., rotation followed by reflection on a plane, but were more in harmony with the modern methods of treatment. The study by the Greeks of the regular solids (fundamental in crystal classification) involved propositions on "golden section," and Professor Archibald pointed out: (1) that Kepler was enthusiastic regarding this "section" (which he termed "divine") and the manner in which it arose in connection with growths and the Fibonacci series; and (2) that these elements were fundamental in a theory, likely to revolutionize the whole modern theory of design, described by Mr. Jay Hambidge in *Dynamic Symmetry: The Greek Vase,* soon to be issued by the Yale University Press.

(3) Dean Pegram stated that the student who has college calculus such as provided by the customary three-hour course for a year should find little difficulty mathematically with any of the literature in the most recent text books and treatises in undergraduate courses in physical chemistry. It would be of advantage to the student of physical chemistry if his course in calculus included some elementary work in the solution of differential equations. Students looking forward to advanced work in chemistry should certainly not be allowed to make the mistake of failing to take such a course in the calculus, and preliminary to this it needs to be assumed that they have had good training in algebra and analytic geometry. The subject of the mathematics of statistics as applied both in the theory of measurements, and more especially in the kinetic theory of gases, is of interest in chemistry, but the demands in this direction appear not to be large at the present time.

Teachers of mathematics in college can perform good service to their students who are looking forward to work in chemistry by utilizing preferably for illustrative purposes equations and processes of the type that occur frequently in physical chemistry. At this point in his paper Dean Pegram cited about fifteen types of algebraic and differential equations which the undergraduate student of physical chemistry should be able to handle. These are for the most part familiar to all teachers of elementary calculus, yet it is of value to have them grouped together as they occurred in Dean Pegram's paper.

The Mariotte-Guy Lussac law, $pv = RT$, with the modified forms:

$$\left(p + \frac{a}{v^2}\right)(v - b) = RT, \qquad \text{(Van der Waals)}$$

$$\left(p + \frac{a}{T(v + c)^2}\right)(v - b) = RT, \qquad \text{(Clausius)}$$

$$p(v - b) = RTe^{-(A/RTv)}. \qquad \text{(Dieterici)}$$

Adiabatic equation of a perfect gas, $pv^k = C$.

Expressions for saturated vapor:

$$\log p = a + b\alpha^t + c\beta^t, \quad \text{(Biot)}$$

$$\log p = \alpha - \frac{\beta}{T} - \frac{\gamma}{T^2}, \quad \text{(Rankine)}$$

$$\log p = k_1 + k_2 \log T - \frac{k_3}{T}. \quad \text{(Hertz-Nernst)}$$

First law of thermodynamics:

$$du = dq - dw = dq - pdv;$$

second law of thermodynamics:

$$ds = \frac{dq}{T},$$

with the incidental training needed here in dealing with partial differentiation, exact differentials and related topics.

Ordinary and partial differential equations of the following types: Monomolecular reaction:

$$\frac{dx}{dt} = k(a - x);$$

bimolecular reaction:

$$\frac{dx}{dt} = k(a - x)(b - x);$$

and similar forms involving three or more factors.

Catalyzed reaction:

$$\frac{dx}{dt} = \frac{k(a - x)}{x^{1/2}}.$$

Diffusion:

$$\frac{\partial c}{\partial t} = D\frac{\partial^2 c}{\partial x^2}.$$

The normal probability curve ($y = ke^{-\gamma^2x^2}$) in finite or differential form, with a similar formula arising in the kinetic theory of gases:

$$dn = \frac{4n}{a^3\sqrt{\pi}}e^{-v^2/a^2}v^2dv.$$

The following were mentioned as the chief texts of interest in this study: Lewes's *System of physical chemistry* (three volumes); Nernst's *Theoretical chemistry*, Washburn's *Physical chemistry*, Partington's *Higher mathematics for students of chemistry*, Mellor's *Higher mathematics for students of physics and chemistry*.

While a good course in calculus prepares a student to do work in physical chemistry, advanced students of chemistry in our universities are finding it very desirable and profitable to put much time on advanced courses in physics and in pure mathematics, since the development of chemistry is sure to be in the direction of more elaborate mathematical formulation of its theory.

In the discussion that followed, Dean Pegram stated that the extent to which the teacher of mathematics should go into the interpretation of these equations is conditioned quite largely by a number of circumstances, such as the student's ability and previous training, the instructor's training and inclination, the place of the mathematics courses in the curriculum relative to the courses in physical chemistry. If the mathematician gives to the student a facility in mathematical operations such as are suggested by these equations, he performs a valuable service. The pupil's interest may well be aroused by giving him the significance of the quantities appearing in these equations if this seems feasible.

Professor Hurwitz mentioned a teacher of thermodynamics who demands considerably more than the amount called for by the speaker, *e.g.*, differential geometry (elliptic, hyperbolic and parabolic points), the non-vanishing of the Jacobian as the condition for reversibility of a transformation. Professor Pegram, however, pointed out that his program had been proposed for undergraduate preparation, not necessarily for graduate students, who might well be expected to continue with more advanced courses suited to their particular needs.

In answer to a question by Professor Burgess, the speaker said that while the ability to fit curves to experimental data may wisely be acquired in undergraduate years if time allows, adequate preparation in the fundamental courses must certainly be assured.

Professor Jackson emphasized the fact that we must be very explicit in our instruction in the fundamental courses, commending the usual and evidently needful practice in thermodynamics of indicating not merely the variable with respect to which the partial differentiation is made, but as well the quantity which is held fast.

(4) In this paper Professor Reed attempted to outline the ideal course of mathematical training for students expecting to enter the field of biometry. In brief this mathematical training consists of courses in algebra, trigonometry, analytic geometry and calculus given in much the usual way, together with a course in the modern statistical methods of treating observed data. This latter should include a discussion of probability leading up to the normal curve, a brief discussion of mechanics treating in particular the principles of moments, and a consideration of methods of treating frequency curves, correlation, and "curve fitting." This statistical theory should be developed from the principles of moments rather than by the familiar "least squares" method as the former is more flexible. The above course would give the student in any of the natural sciences the mathematical background necessary for the treatment of the majority of his problems.

When questioned by Professor Hawkes, Dr. Reed stated that the year course in calculus and a semester course in statistics are sufficient as undergraduate preparation, but that further courses should be added in preparation for research.

Professor Fite emphasized the desirability of some limited amount of probability with examples other than those so commonly drawn from games of chance.

In reply to Professor Richardson, the speaker said that he had for several years given with apparent success a course in calculus, three hours per week for a semester, to students of chemistry, devoting a fair amount of time to drill in using Peirce's *Table of Integrals;* on the other hand Professor Richardson maintained that he had not been able to accomplish this in so short a time. Professor Ransom held that this question depends largely on the number of functions which the student needs to be able to handle, and that for the most part the student in his reading along scientific lines needs not so much to set up the differential equations, nor even to integrate the equations, since the author gives the integration for the cases most commonly met with; rather does he need to be able to understand the language, to know what it is all about. Professor Jackson expressed his agreement with Professor Richardson, said that even after a solid year's course in calculus the student too often fails to get an adequate grasp of the notions of derivative, integral, etc., just as we may in our despair have noted that the last notion the pupil gets in analytic geometry is the connection between the curve and the equation! On the question of brief courses in calculus, integration chiefly by use of tables, etc., Professor Slaught suggested that what is most needed is a certain maturity of judgment and power which can come only through much practice both in translating problems into the language of calculus and in actually carrying out the steps of the work both in differentiation and integration.

(5) Professor Wiley's paper was inserted at the close of the session on Thursday afternoon by unanimous consent. He has been conducting an experiment in handling freshmen by an individual method which contains some unique features. The plan involves: (1) a laboratory arrangement whereby each student works by himself definite assignments which he gets from a head assistant as rapidly as he is able to complete the work satisfactorily; (2) a corps of assistants chosen chiefly from among the best students in the upper classes, who are rewarded partly by the honor conferred upon them, partly by the benefit derived from the practice teaching involved, and partly, in some cases, by tuition exemption; (3) a scheme of credits based upon the completion of certain assignments and the passing of certain general and special tests. Each student has opportunity to confer with the regular instructor as well as with the special assistants, and groups of students working on practically the same assignments are encouraged to confer together and may meet at intervals for joint conference with the instructor.

The paper inspired numerous questions as to the mechanical details and as to the practicability of the scheme, the answers being given for the most part in the above abstract.

(6) Professor Young made a report of progress on behalf of the National Committee on Mathematical Requirements. In addition to news items of interest already published in previous issues of the MONTHLY, announcement was made of the fact that the U. S. Bureau of Education has agreed to publish the reports of the committee. Professor Young also made a plea for coöperation on the part of teachers of mathematics and mentioned several new reports which are in preparation by the committee. A preliminary report on a suggested revision of the work in mathematics of the first two years of the high school is ready for publication and will soon be issued by the Bureau of Education. Copies of this report will be mailed to all members of the Association and of the Society. This report has been discussed by a large number of secondary associations and clubs, and the committee has had the benefit of suggestions from such sources as well as from individuals all over the country. [Compare *1920*, 145–146].

To Dr. Durell's request that the committee would propose as an alternative a plan incorporating a course in algebra as such and a course in geometry as such, since there are many who object to unified courses, Professor Young replied that the report is meant to cover what the committee believes should be the content of the first two years of the high-school course and that the committee does not intend to suggest any preference as between separate and so-called correlated courses.

Professor Dodd expressed his apprehension that where the committee recommends that "more emphasis should be placed on the acquisition of insight and power and less time devoted to acquiring mere facility in the solution of formal exercises," the latter part might unfortunately be observed by teachers the country over without a like endeavor to adopt the first part.

Professor Young also gave a statement of the fundamental considerations on the basis of which it is proposed to revise the present college entrance requirements. Suggestions from any source are desired in this connection. The statement in full follows.

December 30, 1919.

TO THE COUNCIL OF THE MATHEMATICAL ASSOCIATION OF AMERICA:

The National Committee on Mathematical Requirements was requested by your body at your meeting in December, 1918, and by the Council of the American Mathematical Society also in December, 1918, to undertake a reconsideration of the definitions of college entrance requirements as formulated by a Committee of the American Mathematical Society in 1903.

The National Committee is concerned with the study of a desirable reorganization of courses in mathematics in secondary schools and colleges and with proposals for the improvement in the teaching of this subject generally. The subject of college entrance requirements is only one phase of the work for which this committee was organized.

The National Committee felt that it could not profitably attack the problems connected with the revision of college entrance requirements until it was fully acquainted with present tendencies and movements in secondary education relating to mathematics, nor until its own ideas as to desirable changes in secondary school courses in mathematics had assumed a certain degree of definiteness. Accordingly, the consideration of college entrance requirements was postponed. At a meeting of the National Committee on November 1, 1919, however, the problems connected with the desirable mathematical preparation of college students were discussed. We are able, therefore, to make the following preliminary report of progress:

We call attention to the following facts as bearing on the problem under consideration.

(*a*) There is general recognition of the principle that secondary-school courses in mathematics, especially the introductory courses, should be planned so as to be of the greatest possible value to the pupils taking them, whether these pupils ultimately go to college or not. College entrance requirements should not influence the organization or the teaching of such courses to the impairment of their general value.

(*b*) The growth of the junior high school movement is developing a group of courses in mathematics for the seventh, eighth, and ninth school years which may differ in organization and classification of subject matter from the traditional division into elementary algebra, plane geometry, etc. A proper articulation between secondary school and college may make it desirable, even though it be not necessary, to take such new organization of subject matter into account in formulating college entrance requirements.

The results secured under present entrance requirements are unsatisfactory mainly for two reasons:

(*a*) Too many students on entering college lack a sufficient understanding of mathematical principles and sufficient power in applying them.

(*b*) Too many such students are found to be weak in carrying out the simpler, but fundamentally important, operations of arithmetic and algebra.

In our opinion the fault is not as much with the topics listed in the definitions of the "units" of college entrance requirements as it is with the type of instruction generally given. The latter, moreover, is greatly influenced by the character of the prevailing type of entrance examination.

We believe that the definitions of "units" should be revised by eliminating from the requirements in algebra some of the technically more complicated and relatively less useful topics (for example, the extraction of the square root of a polynomial) and by specifying more definitely the extent to which the study of the remaining topics should be carried; in particular, by definitely limiting the difficulty and complexity of the formal manipulative exercises. This would allow more time for securing understanding of principles, for practice in applying them, and for thorough drill in the simpler fundamental operations, both numerical and algebraic.

As previously indicated, however, improvement in the preparation of students entering college must be sought primarily in the instruction in secondary schools. In general this instruction does not place sufficient emphasis on understanding and insight, and is too exclusively concerned with the development of mere skill or facility in formal manipulation. The colleges bear a considerable share of the responsibility for this condition, in that the prevailing type of entrance examination, which exerts a powerful influence on instruction, has overemphasized the formal exercise. Steps should, therefore, be taken to bring about a change in such examinations. They should be more consciously formulated to test the candidate's understanding of principles and his power of applying them, as well as his ability to perform the necessary simple fundamental operations accurately and expeditiously. Formal exercises should be in the minority, instead of the majority as at present. More emphasis should be given to verbal problems and these should be graded with the utmost care as to difficulty and as to the powers which they are intended to test.

There should, moreover, be added to the definition of the "units" a definite statement as to the specific abilities which should be developed (such as the ability to understand and use a formula, the ability to interpret an algebraic result in a concrete setting, the ability to analyze and solve concrete problems, etc.).

The following principles have accordingly been tentatively adopted to govern our proposed reconsideration of college entrance requirements in mathematics:

1. The scholarship implied in the present customary requirement of $2\frac{1}{2}$ units should not be lowered.

2. Drill in algebraic manipulation should be limited to those processes and to the degree of complexity necessary for a thorough understanding of principles and required by the probable applications either in common life or in subsequent mathematics.

3. More emphasis should be given to such immediately useful elementary topics as:

(*a*) The understanding and use of the formula.

(*b*) The interpretation of graphic representation and the use of graphic methods.

4. More emphasis should be placed on the acquisition of insight and power and less time devoted to acquiring mere facility in the solution of formal exercises.

5. While specific minimum requirements in separate subjects like algebra, geometry, etc., are still necessary, adequate provision should be made, perhaps through the so-called comprehensive examination, for the pupils in those schools who are developing "general courses" in mathematics where these subjects are not taught in separate courses.

6. College entrance requirements should be stated not only in terms of subjects and topics but also in terms of specific mathematical abilities to be developed.

7. Means should be found to introduce a proper and desirable amount of flexibility into the requirements in order to encourage progress in secondary education through the experimental introduction of new topics and methods.

On the basis of these principles we hope to formulate our final report for submission to the Council not later than its next summer meeting.

Respectfully submitted, for the Committee,

J. W. YOUNG,
Chairman.

(7) The subject of mathematical needs of students in physics, as presented in Dr. Page's paper naturally divides itself into two parts: first, the mathematical needs of the undergraduate student in physics, and second, those of the graduate.

The elements of algebra and trigonometry are essential prerequisites for an undergraduate course in physics. The parts of algebra of importance are the solution of equations of the first and second degree, simultaneous equations of the first degree, logarithms and exponentials, and the binomial theorem; Dr. Page pleaded for more thorough preparation in these topics and greater practice in their application, even at the expense of those parts of the subject which the undergraduate is likely to have less occasion to use. At the very beginning of his course in physics the student takes up composition and resolution of vectors, and in order to obtain a clear idea of the significance of these directed quantities he must have a good working knowledge of the elements of trigonometry. It is more important that he should be able to distinguish readily sine from cosine when neither side of the angle is horizontal, than that he should be acquainted with a large number of trigonometrical relations which he may never have occasion to use.

Very early in his course in physics, the student takes up derivations which can be explained satisfactorily only by the use of the calculus. It seems unfortunate to the teacher of physics that the college course in general physics is usually given before the student is able to use the calculus; the student's comprehension of the calculus suffers when he is deprived of the excellent opportunity to apply it which is afforded by the study of physics. The tendency to bring into freshman courses in mathematics at least the elements of differentiation and integration was looked upon with favor, and hope was expressed that this movement will permeate down to the last year of high school.

The mathematical preparation of the man who intends to pursue graduate study and engage in research in physics cannot be too thorough. Its value to him is of two kinds: first, it provides him with tools which are essential for his work, and second, it trains him in those habits of logical thought which are exemplified preëminently in mathematical reasoning.

The first requirement of the graduate student in physics is a good course in advanced calculus and ordinary differential equations. Soon after must come courses in partial differential equations, and the study of Legendre's, Bessel's and Laplace's functions, in order to enable him to solve problems in electrostatics and allied subjects. The historical importance of Fourier's series involved in the solution of problems on the flow of heat has been greatly augmented by applications of this form of analysis to the theory of radiation. Some knowledge of the theory of probabilities is essential before courses in statistical mechanics and the kinetic theory of gases are undertaken.

Above all, emphasis was laid on the importance of vector analysis to the student of physics. With few exceptions, all the important quantities with which physics deals are either vectors or the scalar products of vectors. As mathematics is employed by the physicist as a tool in carrying out reasoning in physics, it is important that the notation employed should emphasize the physical rather than the mathematical significance of the logical processes involved. Hence the superiority of vector over scalar analysis. Of the current notations, none is comparable in simplicity and utility to that of Gibbs. One who has been brought up on this form of vector analysis and has made constant use of it cannot help feeling astonished that it has not been universally adopted by physicists.

In discussing this paper Professor Ransom held that while the speakers on the program maintained that students expecting to go into scientific work need a wide acquaintance with mathematics, it is still to be said that many students do not know early enough what courses they need or even that there are mathematical subjects which serve their special purposes. Here is the opportunity for a survey course of a half year, where the instructor advisedly does the greater part of the work and suggests what will be of later use, a course which is profitable for sophomores, certainly for juniors and seniors. Such a course would help in furnishing a better knowledge of the *language* of mathematics. Professor Page replied that the student would doubtless not know of the requirements for, say, electrodynamics and the electromagnetic theory of light, where some such course as Gibbs's vector analysis is essential; he will, if wise, ascertain from his instructor in physics or from some other well informed person what the necessary preparation is. Professor Coolidge described a survey course at Harvard characterized by the students as "seeing mathematics"; the course was elected for the most part by those who had no adequate preparation in earlier mathematics and proved a disillusionment for those who had hopefully inaugurated the plan. Professor Hurwitz instanced a similar course at Cornell in which the instructor refused to make it an easy course, the result being that its enrollment has been very small. He added that uneducated laymen can today pick up a popular science journal and can from this acquire the essential principles of new methods in non-technical language; nevertheless only the exterior results can thus be transmitted, and it is our distinct duty to contribute as far as may be through mathematics also to the development of a well-informed public.

Professor Hawkes made the very important remark that much of what is sought through survey courses can be done by mathematical clubs. We need merely to refer to the past few volumes of the MONTHLY to see how much of this desirable work has actually been accomplished in the live universities and colleges of America. Dr. Helen Owens said that the junior mathematical club at Cornell considers application of mathematics to other subjects, thus enabling students to get preliminary notions of the mathematical courses needed in other branches. The experimental plan, which thus far has included applications to physics, statistics, actuarial work and chemistry, has proved very interesting.

A good natured controversy between Professors Bowden and Page as to whether Professor Gibbs was a pure mathematician or a member of the department of physics, turned the discussion to the question of a coördination between the two departments. Professor Page said that the pure mathematician does not keep closely enough in touch with the experimentalist and his work is apt to suffer so far as its immediate usefulness to the physicist is concerned.

Professor Woods emphasized the portion of the paper that called for those parts of differential geometry and other advanced mathematics which in recent years have become of the utmost importance to the physicist and chemist, *e.g.*, the Einstein theory. He also thinks it unfortunate to teach physics without calculus. Under a new plan at the Massachusetts Institute of Technology, trigonometry is an entrance requirement, the freshman begins with calculus, even before he studies analytic geometry; this course is to be followed by a course in the beginnings of analytic geometry for one term, then further work in calculus.

Meeting of the Council of the Association.

The following seventy-two persons and two institutions, on applications duly certified, were elected to membership:

To individual membership.

W. C. Bartol, A.M. (Bucknell); Ph.D. (Adrian). Prof. of math. and astr., Bucknell Univ., Lewisburg, Pa.

Annette Bennett, A.M. (Columbia). Head of dept. of math., Eureka Coll., Eureka, Ill.

W. N. Birchby, A.M. (Colo. College). Pasadena, Cal.

L. I. Bonney, A.B. (Bates College). Asst. prof., Middlebury Coll., Middlebury, Vt.

F. E. Brasch. Asst. reference librarian, John Crerar Library, Chicago, Ill.

W. M. Brodie, M.E. (Va. Polytech. Inst.); A.M. (Columbia). Prof., Va. Polytech. Inst., Blacksburg, Va.

J. S. Brown, A.M. (Texas). Prof., Southwest Texas St. Normal College, San Marcos, Tex.

Margaret Buchanan, A.B. (West Va. Univ.). Grad. stud., Bryn Mawr Coll., Bryn Mawr, Pa.

S. E. Crowe, A.B. (Ohio State). Asst. prof., Mich. Agric. Coll., East Lansing, Mich.

W. L. Crum, Ph.D. (Yale). Instr., Yale Coll., New Haven, Conn.

R. D. Douglass, A.M. (Maine). Instr., Mass. Inst. of Tech., Cambridge, Mass.

W. F. Downey, A.B. (Amherst). In charge Collins Bldg., English High School Annex, Boston, Mass.

G. C. Evans, Ph.D. (Harvard). Prof., Rice Inst., Houston, Tex.

A. J. Fleisig, A. B. (St. Procopius). Instr., St. Procopius Coll., Lisle, Ill.

C. D. Garlough, A.M. (Illinois). Prof., Wheaton Coll., Wheaton, Ill.

H. H. Gaver, A.M. (Virginia). Instr., U. S. Naval Acad., Annapolis, Md.

R. E. Gilman, Ph.D. (Princeton). Asst. prof., Brown Univ., Providence, R. I.

W. W. Gorsline, B.S. (Chicago). Teacher of collegiate math. and surv., Crane Jun. Coll., Chicago, Ill.

W. C. Graustein, Ph.D. (Bonn). Asst. prof., Harvard Univ., Cambridge, Mass.

T. H. Gronwall, Ph.D. (Upsala); C.E. (Berlin). Math. and dynamics expert, Technical Staff, U. S. Ord., Washington, D. C.

V. G. Grove, A.M. (Kentucky). Asst. prof., Mich. Ag. Coll., E. Lansing, Mich.

H. E. Gudheim, M.E. (Royal Univ. of Tech., Stockholm). Assoc. prof. of graphics, Va. Polytech. Inst., Blacksburg, Va.

Howard Harding, B.M.E. (Michigan). With Rochester Railway and Light Co., Rochester, N. Y.

W. L. Hart, Ph.D. (Chicago). Asst. prof., Univ. of Minnesota, Minneapolis, Minn.

J. R. Hitt, B.S. (Miss. Coll.). Asst. prof., Mississippi Coll., Clinton, Miss.

Yun Huang Ho, A.B. (Cornell). Grad. stud., Cornell University, Ithaca, N. Y.

J. B. Jackson, A.M. (Columbia). Asso. prof., Univ. of South Carolina, Columbia, S. C.

J. S. W. Jones, D.Sc. (Washington Coll.). Prof., Washington Coll., Chestertown, Md.

G. B. King, A.B. (Ark. Cumberland College). Prof., Cumberland Coll., Clarksville, Ark.

J. R. Kline, Ph.D., (Pennsylvania). Asso., Univ. of Illinois, Urbana, Ill.

L. C. Knight, Ph.B. (Wooster). Asst. prof., College of Wooster, Wooster, Ohio.

Elmer Latshaw, Grad. preparatory engineering course (Drexel Inst.) Mech. designing, W. Philadelphia, Pa.

Lena R. Lewis, A.M. (Texas). Head of dept. of math., Thorp Spr. Chr. Coll., Thorp Springs, Tex.

H. M. Lufkin, S.T.B. (Phila. Div. Sch.). Asst., Cornell Univ., Ithaca, N. Y.

R. M. McDill, A.M. (Indiana). Prof., Hastings Coll., Hastings, Neb.

Martha P. McGavock, A.M. (Chicago). Head of dept. of math., Sullins Coll., Bristol, Va.

J. B. Meyer, M.S. (Purdue). Head of dept. of math., St. Normal School, Valley City, N. D.

Norman Miller, Ph.D. (Harvard). Lecturer, Queens Univ., Kingston, Can.

E. B. Mode, B.S. (Boston Univ.). Instr., Boston Univ., Boston, Mass.

H. M. Morse, Ph.D. (Harvard). Benjamin Peirce Instr., Harvard Univ., Cambridge, Mass.

G. W. Mullins, Ph.D. (Columbia). Asst. prof., Barnard Coll., New York, N. Y.

M. A. Nordgaard, A.M. (Maine). Asst. prof., Grinnell Coll., Grinnell, Iowa.

Yeisuke Ono. First Higher School, Tokio, Japan.

Helen B. Owens, Ph.D. (Cornell). Instr., Cornell Univ., Ithaca, N. Y.

S. F. Parson. Head of dept. of math., No. Ill. St. Normal School, De Kalb, Ill.

W. H. Pearce, A.M. (Michigan). Head of dept. of math., Central St. Normal School, Mount Pleasant, Mich.

H. P. Pettit, A.M. (Kentucky). Asst., Univ. of Illinois, Urbana, Ill.

E. C. Phillips, Ph.D. (Johns Hopkins). Prof. of math. and astr., Woodstock Coll., Woodstock, Md.

Hillel Poritsky. Asst. in math. and phys., Cornell Univ., Ithaca, N. Y.

C. Lois Rea, A.B. (Allegheny). Prof. of math. and sc., Cedarville Coll., Cedarville, Ohio.

F. W. Reed, Ph.D. (Virginia). Instr., Cornell Univ., Ithaca, N. Y.

J. N. Rice, Ph.D. (Catholic Univ.). Instr., Catholic Univ., Washington, D. C.

J. M. Robb, A.M. (Michigan). Head of math. dept., high school, Everett, Wash.

G. M. Robison, Ph.D. (Cornell). Instr., Cornell Univ., Ithaca, N. Y.

L. V. Romig, A.M., M.S. (Michigan). Prof., Augustana Coll., Rock Island, Ill.

C. D. ROSE, A.M. (DePauw). Prof. of math. and astr., Nebr. Wesl. Univ., University Place, Neb.
RALEIGH SCHORLING, A.M. (Chicago). Prin., High School, Lincoln School, New York, N. Y.
W. H. SCHUERMAN, C.E. (Cincinnati). Dean of school of eng. and prof. of pure and appl. math., Vanderbilt Univ., Nashville, Tenn.
W. H. SHERK, A.M. (Chicago). Prof. of math., Univ. of Buffalo, Buffalo, N. Y.
G. A. SHOOK, Ph.D. (Illinois). Prof. of math. and physics, Wheaton Coll., Norton, Mass.
C. E. SHULL, A.M. (Bridgewater). Head of dept. of math., Bridgewater Coll., Bridgewater, Va.
J. P. SMITH, A.M. (Woodstock). Prof. of freshman math. and asst. Georgetown Univ. Observ., Washington, D. C.
M. G. SMITH, Ph.D. (Illinois). Head of dept. of math., Greenville Coll., Greenville, Ill.
F. J. TAYLOR, A.B. (St. Thomas). Prof., College of St. Thomas, St. Paul, Minn.
J. S. TAYLOR, Ph.D. (California). Insr., Mass. Inst. of Tech., Cambridge, Mass.
J. A. TOBIN, A.M. (Woodstock). Prof. of trig., anal. geom. and theoretical mech., Boston Coll., Newton, Mass.
R. S. TUCKER, A.B. (Harvard). Instr., Harvard Univ., Cambridge, Mass.
C. B. UPTON, A.M. (Columbia). Asso. prof. of math., Teachers College, Columbia University, New York, N. Y.
H. S. VANDIVER. Instr., Cornell Univ., Ithaca, N. Y.
J. L. WALSH, A.M. (Wisconsin). Grad. student, Harvard Univ., Cambridge, Mass.
E. W. WHITE, A.M. (Columbia.) Dean and prof. of math., Carson and Newman Coll., Jefferson City, Tenn.
C. O. WILLIAMSON, M.S. (Ohio Univ.). Instr. in appl. math., Coll. of Wooster, Wooster, Ohio.

To institutional membership.

NEW HAMPSHIRE COLLEGE, Durham, N. H.
THE COLLEGE OF WOOSTER, Wooster, Ohio.

The Council appointed the following Associate Editors of the MONTHLY for 1920:

ALBERT A. BENNETT,
EDWARD L. DODD,
OTTO DUNKEL,
BENJAMIN F. FINKEL,
CUTHBERT F. GUMMER,
DERRICK N. LEHMER,
HENRY P. MANNING,
RAYMOND B. MCCLENON,
ULYSSES G. MITCHELL,
ELTON J. MOULTON,
DAVID E. SMITH,
HORACE S. UHLER.

It was voted that the incoming president of the Association appoint a committee of five members to report at the summer meeting of the Association on the question of its incorporation and on changes in the constitution necessary to carry such action into effect.

A committee of three was appointed to coöperate with a corresponding committee of the American Mathematical Society, if appointed, to consider the best policy with respect to holding meetings in conjunction in the future.

The invitation of Wellesley College for the Association to hold its summer meeting there in 1921 was referred to this committee.

It was voted that the Association hold its 1920 summer meeting in Chicago if suitable arrangements can be made. A formal invitation has since been received from the University of Chicago.

ANNUAL BUSINESS MEETING OF THE ASSOCIATION.

The secretary-treasurer announced the names of those elected to membership since the summer meeting of the Association. He reported also the death during 1919 of the following six charter members:

C. I. ALEXANDER, professor of mathematics, Texas Christian University (September 7);
C. J. BORGMEYER, professor of mathematics, St. Louis University (December 6);
F. E. CHAPMAN, Gulf Coast Military and Naval Academy (October 1);
W. E. ETZEL, rev. father, College of St. Thomas (February 3);
JAMES MACLAY, professor of mathematics, Columbia University (November 28);
L. G. WELD, director, Free School of Manual Training, Pullman, Ill. (November 28).

The election of officers for the year 1920 was conducted by mail and in person at this meeting, as provided by the constitution. The tellers (ELIZABETH B. COWLEY and A. S. GALE) appointed by the Council reported the result of the balloting as follows, 333 ballots having been cast:

For President: R. G. D. Richardson, 162 votes; D. E. Smith, 168 votes.
For Vice-Presidents: Helen A. Merrill, 198 votes; R. E. Moritz, 105 votes; H. L. Rietz, 164 votes; E. J. Wilczynski, 185 votes.
For additional members of the Council (to serve until January, 1923): R. D. Carmichael, 181 votes; E. L. Dodd, 106 votes; E. R. Hedrick, 215 votes; L. C. Karpinski, 115 votes; D. N. Lehmer, 119 votes; H. E. Slaught, 212 votes; Oswald Veblen, 169 votes; J. W. Young, 205 votes.

The following were accordingly declared elected:

President, D. E. SMITH, Columbia University.
Vice-Presidents: HELEN A. MERRILL, Wellesley College, and E. J. WILCZYNSKI, University of Chicago.
Additional members of the Council: R. D. CARMICHAEL, University of Illinois; E. R. HEDRICK, University of Missouri; H. E. SLAUGHT, University of Chicago; J. W. YOUNG, Dartmouth College.

In accordance with a provision of the constitution of the Association the Council filled two vacancies on its board by the appointment of E. L. DODD, University of Texas, and OSWALD VEBLEN, Princeton University. These vacancies were caused by the election of two members of the Council to offices in the Association.

The secretary was authorized to address a letter to the Director General of Railroads protesting against the arbitrary decision by which scientific societies were refused classification as educational organizations and thereby denied the privilege of reduced rates to members attending the meetings of such societies.

The secretary-treasurer made his financial report for the year, giving an account of all business transacted for the Association up to December 15, 1919. The report of the auditing committee (Mary E. Sinclair, H. E. Slaught, and J. B. Coleman, chairman) was then made. The financial statement is printed in full below.

REPORT OF THE SECRETARY-TREASURER AS TREASURER, DEC. 15, 1919.

Receipts.		
Balance Dec. 2, 1918		$3,728.11
1918 subscriptions	$ 11.10	
1918 indiv. dues	121.72	
1918 instit. dues	12.75	
1919 subscriptions	445.95	
1919 indiv. dues	2,857.03	
1919 instit. dues	404.50	
Initiation fees	114.00	
Sale copies of Monthly	40.82	
Sale reprints	13.71	
Advertising	533.32	
Exchange	.89	
Interest State Savgs. Bk.	84.22	
Interest Peoples Bk.	54.71	
Interest Liberty Bonds	33.57	
Total 1919 receipts		$4,728.29
Total assets up to 1920 business		$8,456.40
Total expenditures		4,317.06
Balance to the end of 1919 business		$4,139.34
Received on 1920 business		441.73
Book balance Dec. 15, 1919		$4,581.07

Expenditures.		
Publisher's bills		$2,578.50
President's office		174.77
Manager's office		25.24
Editor-in-chief's office		182.42
Other editors' postage		18.35
Committee on Membership		2.20
Committee on Dictionary		2.00
Com. on Math. Requirements		58.12
Secretary-Treasurer's office:		
Postage	$203.50	
Bond	5.00	
Office supplies	11.70	
Express, telegrams	7.44	
Clerical work	227.75	
Part expense Register	20.00	
Printing	296.96	
Chicago meeting	54.19	
Michigan meeting	27.83	
Paid to sections from initiation fees	33.50	
Safety deposit rental	2.00	
Pd. copies of Monthly	10.59	
		900.46
Annals subvention		375.00
Total expenditures		$4,317.06
Checking account		500.79
State Savgs. Bk. Co. account		1,998.99
Peoples Bkg. Co. account		1,081.29
Liberty Bond		500.00
Victory Bond		500.00
Bank balance Dec. 15, 1919		$4,581.07

When the accounts were closed on December 15, 1919, in order to furnish the auditing committee a complete record, there remained on the total business for the year 1919 the following items:

BILLS RECEIVABLE.

Advertising	$75.00
1919 dues unpaid	75.00
	$150.00

BILLS PAYABLE.

(Either paid in December or estimated.)

Publisher's bills, Sept.–Dec.	$1,450.00
Register of members	270.00
December *Annals* subvention	75.00
Init. fees due to sections	90.00
President's office	15.00
Manager's office	15.00
Editor-in-chief's office	30.00
Secretary-treasurer's office	130.00
Printing annual ballot, programs, etc.	125.00
Additional postage	50.00
	$2,250.00

If to the balance on 1919 business shown in this report, $4,139.34, there be added the amounts of bills receivable, $150 and there be subtracted the estimated amount of bills payable, $2,250, there results an estimated final balance on 1919 business of approximately $2,040. Of this surplus, about $1,000 was passed over to the Association by the management of the MONTHLY when the Association was organized, and this fund is kept by the Council of the Association as a reserve fund. The result for the year's finances is favorable, except for the fact faced one year ago but now made real, viz., an increased rate in the cost of printing dating from August 1, 1919, the exact rates not as yet having been announced by the publishers; this with the steadily decreasing amount derived from advertising makes it necessary to exercise all due care with regard to the expenses of the organization.

W. D. CAIRNS, *Secretary-Treasurer.*

THE NOVEMBER MEETING OF THE ILLINOIS SECTION.

The first program meeting of the Illinois Section of the Mathematical Association of America was held in room 418 Natural History Building, University of Illinois, on November 22, 1919. There were fifty-nine persons present including the following twenty-four members of the Association: Blumberg, Camp, R. D. Carmichael, Coble, Comstock, Crathorne, Emch, Foberg, Garlough, Kempner, Kustermann, Lytle, McNeill, Bessie I. Miller, G. A. Miller, Risley, Rosenbach, G. H. Scott, Shaw, Slaught, Steimley, E. L. Thompson, Townsend, and Wahlin.

The following program was given: (1) Address: H. E. Slaught, President of the Mathematical Association of America. (2) Round Table Discussion of the Topic:—Freshman Mathematics as related to varying admission credits from the high schools. Discussion led by C. E. Comstock, Bradley Polytechnic Institute, M. W. Coultrap, Northwestern College, G. C. Heritage, Crane Junior College. (3) Address: The Training of Mathematics Teachers, E. B. Lytle, University of Illinois. Discussed by Malcolm McNeill, Lake Forest College, Bessie I. Miller,